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CHAPTER 6

ROADWAY

6.00.00 GENERAL PROVISIONS

6.01.00 APPLICABILITY

This chapter contains minimum criteria to be met on all streets and parking lots designed and constructed in the City, both the Responsible Party's and by the City. All work performed according to this section must comply with the general requirements contained within Chapter 1 and the acceptance requirements of Chapter 10.

6.02.00 PRIVATE STREET SYSTEMS AND PARKING LOTS

Private street systems and parking lots shall be subject to all minimum requirements of these STANDARDS AND SPECIFICATIONS. Traffic studies may be required by the City of Delta, refer to Section 8.10.00 for the requirements and requirements of such study.

6.03.00 CITY CAPITAL IMPROVEMENT PROJECTS

It is recognized that the minimum requirements contained in these STANDARDS AND SPECIFICATIONS are not necessarily sufficient for plans, specifications, and contract administration purposes for City administered street capital improvement projects. Accordingly, the City Representative is authorized to develop and/or approve such additional requirements and procedures necessary for bidding, awarding, and administering for such projects, provided said additional requirements and procedures are substantially consistent with these STANDARDS AND SPECIFICATIONS and applicable provisions of other City ordinances and resolutions.

6.10.00 ROADWAY DESIGN AND TECHNICAL CRITERIA

This section sets forth the minimum design and technical criteria and specifications to be used in the preparation of all roadway plans. Within this chapter, AASHTO "Green Book" refers to "A Policy on Geometric Design of Highways and Streets -- 1990" as published by the American Association of State Highway and Transportation Officials.

Design of streets within a defined "estate subdivision" shall be in accordance with the most current City Subdivision Regulations within the City Municipal Code.

6.11.00 LOCAL STREET

6.11.01 Local

A rural local street is a general term denoting a roadway designed or operating with the following characteristics:

- (A) **Posted Speed Limit.** Between 25 and 30 miles per hour. Posted or prima facia speeds for the various street classifications are normally five (5) to ten (10) miles per hour less than the design speed of that street.
- (B) **Traffic Volumes.** Less than 2,500 vehicles per day.
- (C) **Limited Continuity.**

- (D) **Safety.** Designed for the safety of pedestrians and bicyclists and the ease of access to adjacent parcels of land.
- (E) **Traffic Control.** Stop signs or right-of-way rules for uncontrolled intersections. Traffic requirements in other than residential areas may require special design consideration by the applicant's engineer and the City's Traffic Control Designee.
- (F) **Function.** Local streets provide direct access to adjacent property. Traffic carried by local streets should have an origin or a destination with the neighborhood. Local streets are utilized in single family residential areas. Utility line easements should be available.
- (G) **Right-of-Way.** Fifty feet (50') minimum.
- (H) **Number of Moving Lanes.** Two.
- (I) **Access Conditions.** In accordance with Chapter 8 of these STANDARDS AND SPECIFICATIONS.
- (J) **Planning Characteristics.** Rural local streets should not intersect major arterial streets.
- (K) **Type of Curb and Gutter.** Six inch (6") vertical curb and twenty-four (24") inch gutter. Combination curb, gutter, and sidewalk, conforming to the standard detail in the Appendix of this chapter, may be installed on local streets only, and only with approval from the City of Delta.
- (L) **Sidewalk Width.** Five foot (5') minimum. Detached from curb or as per combination curb, gutter and sidewalk detail in the Appendix of this chapter.
- (M) **Cul-De-Sacs.** In accordance with Section 6.20.00 of these STANDARDS AND SPECIFICATIONS.
- (N) **Street Widths.** Thirty-four foot (34') paved width plus two (2) two foot (2') gutter pans.

6.12.00 COLLECTOR STREET

6.12.01 Collector

A collector is a general term denoting a roadway designed or operating with the following characteristics:

- (A) **Posted Speed Limit.** Between 25 and 30 miles per hour. Posted or prima facia speeds for the various street classifications are normally five (5) to ten (10) miles per hour less than the design speed of that street.
- (B) **Traffic Volumes.** Generally less than 7000 vehicles per day.
- (C) **Continuous.** For less than two (2) miles.

- (D) **Safety.** Designed to handle traffic volumes loading from and onto local, other collector, and arterial roadways.
- (E) **Traffic Control.** Regulation of traffic accomplished through the use of stop signs and channelization. Traffic signals normally used only at intersections with major collectors and arterial streets.
- (F) **Driveways.** No back-out drives permitted.
- (G) **Function.** Collector streets collect and distribute traffic between arterial and local streets and serve as main connectors within communities, linking one neighborhood with another. Traffic carried by collector streets should have an origin or a destination within the community. Rural collectors are utilized in rural areas where average lot size exceeds one acre. Utility easements should be available.
- (H) **Right-of-Way Width.** Sixty-foot (60') minimum.
- (I) **Number of Moving Lanes.** Two (2).
- (J) **Access Conditions.** In accordance with Chapter 8 of these STANDARDS AND SPECIFICATIONS.
- (K) **Planning Characteristics.** Collector streets should have continuity throughout a neighborhood but need not extend beyond the neighborhood intersections with collectors, major collectors, and arterial streets should be at least one-quarter (1/4) mile apart.
- (L) **Type of Curb and Gutter.** Six (6) inch vertical and twenty-four (24") inch gutter.
- (M) **Sidewalk Width.** Five foot (5') minimum. Detached from curb.
- (N) **Street Widths.** Thirty-eight foot (38') paved width plus two (2) - two foot (2') gutter pans.

6.13.00 ARTERIAL STREET

6.13.01 Minor Arterial

An arterial street is a general term denoting a roadway designated or operating with the following characteristics:

- (A) **Posted Speed Limit.** Between 40 and 45 miles per hour. Posted or prima facie speeds for the various street classifications are normally five (5) to ten (10) miles per hour less than the design speed of that street.
- (B) **Traffic Volumes.** Twelve thousand (12,000) vehicles per day expected minimum traffic volume when the land which the arterial serves is fully developed.

- (C) **Access.** In accordance with Chapter 8 of these STANDARDS AND SPECIFICATIONS.
- (D) **Continuity.** Several miles, generally connecting with inter-city routes.
- (E) **Traffic Control.** Regulation of traffic accomplished by signs and channelization. Traffic signals will normally be located only at intersections with streets of high classification. Parking should be prohibited.
- (F) **Function.** Arterial routes permit relatively unimpeded traffic movement and are intended for use on these routes where four (4) moving lanes and one (1) left-turn lane are required but where a major arterial cross-section would not be warranted. No parking is allowed.
- (G) **Right-of-Way Width.** Eighty feet (80') minimum.
- (H) **Number of Moving Lanes.** Four (4).
- (I) **Planning Characteristics.** Arterials should be spaced from one-half (1/2) to one (1) mile apart and should, where possible, be continuous. Arterials should act as boundaries between neighborhood areas. Arterial cross-section should be employed where traffic demands are high and right-of-way acquisition costs are prohibitive. Detached sidewalk required. Separate major land uses.
- (J) **Type of Curb and Gutter.** Six inch (6") vertical and twenty-four inch (24") gutter.
- (K) **Sidewalk Width.** Five-foot (5') minimum, detached from curb, or as required by the City Representative.
- (L) **Street Widths.** Two (2) twelve-foot (12') travel lanes, two (2) ten-foot (10') travel lanes with two (2) two-foot (2') gutter pans. Total street width shall be forty eight feet (48') flowline to flowline.

6.13.02 Principal Arterial (4-Lane)

- (A) **Posted Speed Limit.** Greater than or equal to 40 miles per hour. Posted or prima facie speeds for the various street classifications are normally five (5) to ten (10) miles per hour less than the design speed of that street.
- (B) **Traffic Volumes.** Nineteen thousand (19,000) vehicles per day expected minimum traffic volume when the land which the arterial serves is fully developed.
- (C) **Access.** In accordance with Chapter 8 of these STANDARDS AND SPECIFICATIONS.
- (D) **Continuity.** Several miles, generally connecting with inter-city routes.
- (E) **Traffic Control.** Movement of traffic will be controlled by signals and channelization. Parking shall be prohibited. Roadways should have a raised median strip between them.

- (F) **Function.** Major arterial streets permit rapid and relatively unimpeded traffic movement throughout the country, connecting major lane use element, as well as communities with one another. No parking is allowed.
- (G) **Right-of-Way Width.** One-hundred feet (100') minimum.
- (H) **Number of Moving Lanes.** Four (4).
- (I) **Planning Characteristics.** Major arterial streets should be spaced approximately one (1) mile apart and should traverse the entire city. Major arterial streets should not bisect neighborhoods but should act as boundaries between them.
- (J) **Type of Curb and Gutter.** Six (6) inch vertical with twenty-four inch (24") gutter on outside of traveled way; six (6) inch vertical with one foot (1') pan on medians.
- (K) **Sidewalk Width.** Five-foot (5') minimum, detached from curb, or as required by the City Representative.
- (L) **Street Widths.** Two (2) twelve-foot (12') travel lanes and two (2) ten-foot (10') travel lanes with two (2) two-foot (2') gutter pans, from one (1) sixteen foot (16') raised median, two (2) one-foot (1') median gutter pans, plus necessary left-turn and acceleration/deceleration lanes, and minimum four-foot (4') raised median at intersections. Total street width shall be sixty-four feet (64') flowline to flowline.

6.14.00 DRAINAGE

6.14.01 Crosspans

Crosspans shall be constructed in accordance with the detail drawing. Crosspans are not permitted across collector or arterial roadways. Double crosspans may be used parallel to collectors or arterial roadways to convey storm runoff across residential roadways. The use of double crosspans elsewhere, or the use of any crosspan on roadways where the vertical grade exceeds four-and-one-half percent (4.5%) will be considered only after all alternatives have been exhausted.

6.14.02 Inlets

Inlets shall be located to intercept the curb flow at the point curb flow capacity is exceeded by storm runoff. Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevation. Due to the presence of handicap ramps, inlets shall not be allowed in the curb return but shall be located outside the tangent points of the curb returns. Gutter transition sections abutting inlets shall not be within the curb return.

6.14.03 Sidewalk Chases

Storm water from concentrated points of discharge shall not be allowed to flow over sidewalks but shall drain to the roadway or storm inlet by use of chase sections. Sidewalk chase sections shall not be located within a curb cut or driveway. Sidewalk chase sections shall be constructed in accordance with the detail drawing.

6.14.04 Temporary Erosion Control

Temporary erosion control is required along and at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with Chapter 2 of these STANDARDS AND SPECIFICATIONS.

6.15.00 HORIZONTAL ALIGNMENT

6.15.01 Horizontal Curves

The minimum horizontal curves for roadway alignment shall be in accordance with Table 6.15.01 below.

TABLE 6.15.01
Horizontal Curves

<u>Design Speed (MPH)</u>	<u>Average Running Speed (MPH)</u>	<u>Maximum Degree of Curvature</u>	<u>Minimum Curve Radius*(Feet)</u>
20	20	57.3	100
25	24	32.7	175
30	28	22.9	300
35	32	14.3	475
40	36	8.8	650
50**	44	6.0	955
55**	48	4.75	1200

* AASHTO Figure 111-18 - for low speed urban street - normal crown.

** Requires Superelevation - 0.04 ft/ft maximum.

6.15.02 Curb Return Radius

Minimum return radius shall be as shown in Table 6.09.02 below.

TABLE 6.15.02
Curb Return Radii
(Measured Along Flowline)

<u>Through Street</u>	<u>Intersecting Streets</u>		<u>Local Service</u>
	<u>Arterial</u>	<u>Collector</u>	
Arterial	50 Feet	30 Feet	25 Feet
Collector	30 Feet	25 Feet	20 Feet
Local Service	25 Feet	20 Feet	15 Feet

6.15.03 Design Speed

Horizontal alignment design speed shall be consistent with the requirement for vertical alignment design speed. If no superelevation is required and normal crown section exists, the horizontal curve data as shown in Table 6.15.01 shall be used.

6.15.04 Spiral Curves

Spiral curves shall be used only on arterial roadways within the City of Delta and only upon written approval of the City Representative.

6.15.05 Small Deflection Angles

For small deflection angles, curves should be sufficiently long to avoid the appearance of a kink. Curves should be at least five hundred (500) feet long for a central angle of five degrees (5°), and the minimum length should be increased one hundred feet (100') for each one-degree (1°) decrease in the central angle. Horizontal curves should not be used when the central angle is fifty-nine minutes (59') or less.

6.15.06 Compound Curves

A compound curve on arterials should be avoided, particularly where a simple curve can be obtained at small extra cost. Where topography makes their use necessary, the radius of the flatter curve should not be more than fifty percent (50%) greater than the radius of the sharper curve. When this is not feasible, an intermediate curve or spiral should be used to provide the necessary transitions. Spiral curves are only to be used upon written approval of the City Representative.

6.15.07 Reversing Curves

True reversing curves should not be used. In cases of reversing curves, a sufficient tangent should be maintained to avoid overlapping of the required superelevation runoff and tangent runoff. The following is the minimum tangent lengths that shall be used for each roadway classification:

- (A) Local -- not applicable.
- (B) Collector -- Fifty feet (50') minimum.
- (C) Arterial -- One hundred feet (100') minimum.

6.15.08 Broken-Back Curves

A broken-back curve consists of two (2) curves in the same direction joined by a short tangent, of length less than one thousand five hundred feet (1500'). Broken-back curves are undesirable. If the length of intervening tangent is less than one thousand five hundred feet (1500'), a simple curve, a compound curve, or spiral transitions should be used to provide some degree of continuous superelevation. Spiral curves are only to be used upon written approval of the City Representative.

6.15.09 Alignment at Bridges

Ending a curve on a bridge is undesirable and adds to the complication of design and construction. Likewise, curves beginning or ending near a bridge should be so placed that no part of the spiral or superelevation transitions extends onto the bridge. Compound curves on a

bridge are equally undesirable. If curvature is unavoidable, every effort should be made to keep the bridge within the limits of the simple curve.

6.15.10 Coordination With Vertical Alignment

To avoid the possibility of introducing serious traffic hazards, coordination is required between horizontal and vertical alignment. Particular care must be exercised to maintain proper sight distance at all times. Sharp horizontal curves introduced at or near the top of pronounced crest or bottom of sag vertical curves should be avoided. Vertical curvature superimposed upon horizontal curves, or vice versa, generally results in a more pleasing facility.

6.16.00 VERTICAL ALIGNMENT

Vertical Alignment Control Table

Design Controls for vertical alignment are shown on Table 6.16.00.

TABLE 6.16.00
Vertical Alignment Controls

Description	Design Speed*	Maximum Grade**	K Value Ranges		Minimum VCL	
			Crest	Sag	Crest	Sag
Local	35	7	40-50	50-50	50	50
Minor Collector	40	7	60-80	60-70	50	50
Minor Arterial	50	5	110-160	90-110	100	80
Principal Arterial***	55	5	150-220	100-130	110	90

* The design speed is a minimum of 5 miles per hour over the posted speed for each classification.

** The maximum grades indicated should only be used in extreme topographic conditions. The designer should strive to minimize the use of these grades for considerable lengths and on north-facing slopes.

*** K values exceeding 125 on curbed streets should be checked for drainage. Multiple inlets may be required within long sag on vertical curves, and where the longitudinal slope is less than 0.4 percent.

6.16.01 Permissible Roadway Grade

The minimum allowable grade for roadways is one-half percent (0.5%). The minimum allowable grade for bubbles and cul-de-sacs within the bulb is one percent (1%). The maximum allowable grade for any roadway is shown in Table 6.16.00 above.

6.16.02 Permissible Intersection Grades (Public Rights-of-Way)

The maximum permissible grade at intersections shall be as shown in the detail drawing. These grades are maximum instantaneous flowline grades for the stated distances (each side of the street) for the minor (intersecting) street. Desirable intersection grades should be in the range of one percent (1%) to three percent (3%) of all intersecting streets with the limit of two percent (2%) for arterials.

The intersection grade of the major (through) street at the intersection may be dictated by design

considerations for the street. However, if the major street intersection grade exceeds three percent (3%), the type of access and access control will be as directed by the City Representative.

All private commercial driveways with curb return radii shall follow the standards set forth for a local street. The length of the maximum grade for the commercial driveway shall be a minimum of fifty feet (50') measured from the flowline intersection of the public roadway.

6.16.03 Changing Grades

The use of grade breaks in lieu of vertical curves is discouraged. However, if a grade break is necessary and the algebraic difference in grade does not exceed eight-tenths of a percent (0.008 ft./ft.) along the roadway, the grade break will be permitted. The maximum grade break allowed at the point of tangency at a curb return for local and collector roads shall be two percent (2%) and for arterial roadways a maximum of one percent (1%).

6.16.04 Vertical Curves

When the algebraic difference in grade (A) is at, or exceeds, eight-tenths of a percent, a vertical curve is to be used. Design criteria for vertical curves is found in Table 6.16.00 of this chapter. The minimum gradients into and out of a sag (sump) vertical curve is five-tenths of a percent (0.005 ft./ft.). Minimum length of a vertical curve is shown in Table 6.10.00 of this chapter. All vertical curves shall be labeled in the profile with length of curve (L), $K=L/A$ values, VPC, VPT, VPI, and stationing and elevation of these components. In addition, the low point or high point of the vertical curve shall be shown.

6.16.05 Intersections

In addition, the following criteria shall apply at intersections.

- (A) The grade of the "through" street shall take precedence at intersections. At the intersections of roadways with the same classification, the more important roadway, as determined by the City Representative, shall have this precedence. The design should warp side streets to match through streets with as short a transition as possible.
- (B) The key criteria for determining the elevation of the curb return on the side street and the amount of warp needed on a side street transitioning to a through street are:
 - 1. Permissible grade in the stop/start lane. See Section 6.16.02 of these STANDARDS AND SPECIFICATIONS.
 - 2. Pavement cross slope at the PCR's on the side street and permissible warp in pavement cross slope.
 - 3. Normal vertical curve criteria.
 - 4. Vertical controls within the curb return itself.
- (C) The elevation at the PCR of the curb return on the through street is always set by the grade of the through street in conjunction with pavement cross slope.
- (D) Carrying the crown at a side street into the through street is permitted only when

drainage considerations warrant such a design.

- (E) A more detailed review shall be performed for arterial-arterial intersections to maximize driveability. A few arterial intersections will have a uniform two percent (2%) cross-slope, the majority of them having one or more sides warped.
- (F) Whenever possible, intersections shall be made at right angles or radial to a curve. No intersecting angle of less than seventy-five degrees (75°) will be allowed.

6.16.06 Curb Returns

Minimum fall around curb returns for flow along the curb line shall be as follows:

Table 6.16.06
Curb Returns

<u>Radius</u>	<u>Minimum Fall</u>
15 Feet	0.3 Feet
20 Feet	0.3 Feet
25 Feet	0.4 Feet
30 Feet	0.4 Feet
50 Feet	0.5 Feet
All Others	1.2 Percent Around the Return

6.16.07 Curb Return Profiles

Curb return profiles are required for radii equal to or greater than twenty five (25') within the public right-of-way. A mid-point elevation along the arc length of the curb return shall be shown in plan view for radii equal to or greater than twenty-five feet (25'). Curb return design shall be set in accordance with the following design procedure. General standards for flowline control and profiles with the curb returns shall be as follows:

- (A) The point of tangency at each curb return shall be determined by the projected tangent grade beginning at the point of intersection (PI) of the flowlines.
- (B) The arc length and external distances of the curb return shall be computed and indicated on the drawing.
- (C) Show the projected flowline (or top of curb) grade for each roadway beyond the PCR.
- (D) Design the flowline of the curb return such that a maximum cross slope between the mid-point of the curve and the PICR (external distance) does not exceed five percent (5%). Grade breaks at the PCRs shall not exceed two percent (2%) for local and collector streets and one percent (1%) for arterials. The flowline design of the curb return shall be accomplished within the return without affecting street grades beyond the PCR. Maximum vertical curves will equal the arc length of the curb return. The elevation and location of the high or low point within the return, if applicable, is to be called out in the profile.
- (E) Scale for the curb return profile to be one inch equals one foot (1"=1') vertically.

6.16.08 Connection With Existing Roadways

- (A) Connection with existing roadways shall be smooth transitions conforming to normal vertical curve criteria if the algebraic difference in grade between the existing and proposed grade exceeds eight-tenths (0.008 ft./ft.) of a percent. When a vertical curve is used to make this transition, it shall be fully accomplished prior to the connection with the existing improvements and shall also comply with the grade requirements at intersection approaches.
- (B) Existing grade shall be shown for at least three hundred feet (300') with field verified record drawings showing stations and elevations at twenty-five-foot (25') intervals. In the case of connection with an existing intersection, these record drawings are to be shown within a three-hundred-foot (300') radius of the intersection. This information will be included in the plan and profile that shows that proposed roadway. Limits and characteristics of the proposed improvement are the primary concern in the plan view. Such characteristics include horizontal alignment, off-site intersections, limits of the improvement, etc.
- (C) Previously approved designs for the proposed improvement are not an acceptable means of establishing existing grades. However, they are to be referenced on the construction plan where they occur.
- (D) The basis of the as-built elevations shall be the design elevations (both flowline or both top of curbs, etc.) when possible.

6.17.00 SIGHT DISTANCES

6.17.01 General

The major considerations in alignment design are safety, grade, profile, road area, design speed, sight distance, topography, drainage, and performance of heavy-duty vehicles. The road alignment should provide for safe and continuous operation at a uniform design speed. New road layout shall bear a logical relationship to existing or platted roads in adjacent properties. Design for site distances shall be in accordance with the following:

Adequate intersection design necessitates the provision of safe ingress and egress from one street or driveway to the other, based in part on the ability of a driver to see oncoming vehicles or pedestrians. The following guidelines shall be used in the design of intersections, private driveways and public streets that intersect other traffic carrying facilities.

6.17.02 Sight Distance Triangle

At the intersection of two public streets or a private driveway and a public street, sight distance shall be evaluated across a “sight distance triangle” where obstructions are restricted according to the following criteria. Within the area of the triangle there must be no wall, fence, sign, foliage, berming or other structure which will obscure the driver’s view of traffic approaching that intersection. The structures or berms within the sight distance triangle can extend no higher than 24 inches above the curb elevation and no lower than eight feet above the curb. Exceptions to this requirement exist for public facilities such as fire hydrants, utility poles and traffic control devices. These facilities must be located to minimize visual obstruction.

The evaluation of sight distance shall be made on two different types of sight distance areas. The first is shown in Figure 6.17.01 for the intersection of two public streets. The sight distance triangle in this case is formed by the intersection of two lines plotted along the curb line of the intersecting streets using the specified lengths. The diagonal connects the other ends of those lines. Where one or the other of the intersecting streets/driveways has no curb, the lines are plotted along the edge of the traveled way.

The second sight distance triangle is shown in Figure 6.17.02, and is formed by lines plotted along the flowlines or edge of traveled way of both streets and the diagonal lines d_1 and d_2 as shown. Distance d_1 is measured to vehicles approaching from the left and d_2 is measured to those approaching from the right. The sight lines (d_1 and d_2) have their origin at the stopped driver’s eye, located ten feet (10’) behind the flowline of the street being entered.

Tables 6.17.01 through 6.17.04 show recommended sight distances d_1 , and d_2 for passenger vehicles and semi-tractor trailer trucks for several different vehicle operating speeds and roadway configurations. The tables were developed according to the following general criteria:

1. Vehicles turning left or right can accelerate to the operating speed of the intersecting street without causing approaching vehicles to reduce speed by more than ten miles per hour.
2. Vehicles turning left can clear the near half of the street without conflicting with vehicles approaching from the left.
3. The distance requirements are based on the driver’s eye being 3.5 feet above the roadway and an object height of 4.25 feet. For semi-tractor trailers, a six foot driver’s eye height and a 4.25 feet object height are assumed.
4. The operating speed on each approach is assumed to be (in the order of desirability):
 - A. The 85th percentile speed;
 - B. The speed limit, if based on a traffic engineering study;
 - C. The design speed in the case of a new facility.

When the criteria for sight distance cannot be met, the City may prohibit certain turns by exiting vehicles to provide safe operating conditions. These standards apply to accesses on State Highways and City streets.

TABLE 6.17.01

Sight Distance (feet) for Passenger Cars Exiting from Private Accesses or Public Streets onto Two-Lane Roads

Speed (mph)	Safe Sight Distance – Left ¹ d ₁	Safe Sight Distance - Right ¹ d ₂
20	150	130
25	240	200
30	350	260
35	430	350
40	530	440
45	610	570
50	740	700
55	830	860
60	950	1,050

¹ Measured from the driver's eye ten feet back of the flowline or pavement edge.

TABLE 6.17.02

Sight Distance (feet) for Passenger Cars Exiting from Private Accesses or Public Streets onto Four and Six-Lane Roads

Speed (mph)	Safe Sight Distance – Left ¹ d ₁	Safe Sight Distance - Right ² d ₂
20	130	130
25	180	200
30	220	260
35	300	350
40	380	440
45	500	570
50	620	700
55	760	860
60	950	1,050

¹ Measured from the driver's eye ten feet back of the flowline or pavement edge to a vehicle in the outside lane.

² Measured from the driver's eye ten feet back of the flowline or pavement edge to a vehicle approaching in the median lane.

TABLE 6.17.03

Sight Distance (feet) for Semi-Trailers Exiting from Private Accesses or Public Streets onto Two-Lane Roads

Speed (mph)	Safe Sight Distance – Left ¹ d ₁	Safe Sight Distance - Right ² d ₂
20	300	200
25	400	320
30	680	400
35	850	640
40	1,160	850
45	1,600	1,160
50	2,000	1,600
55	2,500	2,000
60	950	2,500

¹ Measured from the driver's eye ten feet back of the flowline or pavement edge.

² Measured from the driver's eye ten feet back of the flowline or pavement edge to a vehicle approaching in the median lane.

TABLE 6.17.04

Sight Distance (feet) for Semi-Trailers Exiting from Private Accesses or Public Streets onto Four and Six-Lane Roads

Speed (mph)	Safe Sight Distance – Left ¹ d ₁	Safe Sight Distance - Right ² d ₂
20	200	200
25	320	320
30	400	400
35	640	640
40	850	850
45	1,160	1,160
50	1,600	1,600
55	2,000	2,000
60	2,500	2,500

¹ Measured from the driver's eye ten feet back of the flowline or pavement edge.

² Measured from the driver's eye ten feet back of the flowline or pavement edge to a vehicle approaching in the median lane.

The sight distance shown in Tables 6.17.05 and 6.17.06 are required for vehicles turning left from a public street to allow them a clear view of oncoming vehicles and complete the maneuver safely.

TABLE 6.17.05

Sight distance (ft.) for Passenger Cars Entering Private Accesses or Public Streets by Left Turns from a Public Street

Speed (mph)	Safe Sight Distance in Feet ¹		
	2-Lane	4-Lane	6-Lane
20	150	160	170
25	190	200	220
30	230	250	270
35	300	320	340
40	370	390	420
45	450	470	500
50	520	550	580
55	600	630	670
60	700	740	780

¹ Measured from the point where a left turning vehicle stops to a vehicle approaching in the outside lane.

TABLE 6.17.06

Sight distance (ft.) for Semi-Trailers Entering Private Accesses or Public Streets by Left Turns from a Public Street

Speed (mph)	Safe Sight Distance in Feet ¹		
	2-Lane	4-Lane	6-Lane
20	260	280	300
25	330	360	380
30	400	440	480
35	480	540	580
40	570	620	670
45	680	730	800
50	810	880	950
55	910	990	1,060
60	1,000	1,100	1,200

¹ Measured from the point where a left turning vehicle stops to a vehicle approaching in the outside lane.

The sight distances in Tables 6.17.01 and 6.17.04 apply when highway grades are zero to 3.0% (either up or down). When grades are steeper than 3.0%, adjustments must be made to compensate for the different distances required to reach the speed of highway traffic. Adjustment factors are provided in Table 6.17.07.

TABLE 6.17.07

Factors for the Effect of Grade on Sight Distance

Grade	Downgrade Factor ¹	Upgrade Factor ²
0 – 3%	1.0	1.0
3.1 - 5%	0.6	1.4
5.1 - 8%	0.5	1.7

¹ When the highway in the section to be used for acceleration after leaving the access descends, sight distance in the direction of approaching descending highway traffic should be reduced by these factors.

² When the highway in the section to be used for acceleration after leaving the access ascends, then sight distance in the direction of approaching ascending should be increased by these factors.

6.18.00 ROADWAY CROWN

6.18.01 Cross Slope

Except at intersections or where superelevation is required, roadways shall be level from top of curb to top of curb (or flowline to flowline) and shall have a minimum two percent (2%) crown. Within one-hundred-fifty feet (150') of an intersection, the maximum elevation difference between flowlines shall be dictated by the allowable intersection grade and the actual distance between flowlines.

- (A) Parabolic or curved crowns are not allowed. In no case shall the pavement cross slope at warped intersections exceed the grade of the through street.
- (B) The rate of change in pavement cross slope when warping side streets at intersections shall not exceed one percent (1%) every twenty-five feet (25') horizontally on a local roadway, one percent (1%) every thirty-seven-and-one-half feet (37.5') horizontally on a collector roadway, or one percent (1%) every fifty-six-and-one-half feet (56.5') horizontally on arterial roadway.

6.18.02 Superelevation

Superelevation is required for curves on all arterial roadways and selected collector roadways. Horizontal curve radius on superelevation shall be in accordance with the recommendations of the AASHTO "A Policy on Geometric Design of Highways and Streets", latest edition (Green Book).

Superelevation shall not be used on local or other roadway classifications with a design speed of 40 miles per hour or less. The following procedure is an outline for the correct application of superelevation on roadways within the City of Delta.

(A) Definitions Regarding Superelevation:

Superelevation Runoff. That length of roadway needed to accomplish the change in cross slope from a section with the adverse crown removed (flat) to the fully superelevated section, or vice versa.

Transition Points. Beginning or ending of tangent run-out, superelevation runoff, or full superelevation.

Tangent Run-Out. That length of roadway needed to accomplish the change in cross slope from a normal (2 percent) crown section to a section with the adverse crown removed (flat), or vice versa.

(B) General:

One of the most important factors to consider in highway safety is the centrifugal force generated when a vehicle traverses a curve. Centrifugal force increases as the velocity of the vehicle and/or the degree of curvature increases. In order to overcome the effects of centrifugal force, curves should be superelevated. It is impossible to balance centrifugal force by superelevation alone because for any given curve radius a certain superelevation rate is exactly correct for only one driving speed. At all other speeds there will be a side thrust either outward or inward, relative to the curve center, which must be offset by side friction.

(C) Standards for Superelevation:

AASHTO's Green Book, Table 111-8 on superelevation give the required rates of superelevation for the various degree of curvature. Maximum superelevation rate of 0.04 foot per foot are commonly used on major streets.

(D) Urban Street Conditions:

Every effort should be made to maintain standard rates of superelevation. However, in urban areas street intersections, established street grades, curbs, and drainage conditions may require a reduction in the rate of superelevation or different rates for each half of the road bed. In warping areas for drainage, adverse superelevations should be avoided.

6.19.00 SIDEWALKS, CURB AND GUTTERS, RAMPS, AND DRIVEWAYS

- (A) Roadway typical sections shall be as specified by these STANDARDS AND SPECIFICATIONS.
- (B) Sidewalks or bicycle paths shall be constructed on both sides of all roadways unless approved by the City of Delta.
- (C) All sidewalks used in conjunction with vertical curb and gutter shall have a minimum width of five feet (5').
- (D) Vertical curb, gutter, and detached walk shall be used on all occasions. Combination curb, gutter, and walk may be approved for use only on local streets and in certain circumstances and must be approved in advance by the City Representative.

- (E) State law requires that handicap ramps be installed at all intersections and at certain mid-block locations for all new construction of curb and sidewalk [CRS 43-2-107(2)]. Handicap ramps shall be constructed in accordance with the detail drawings in these STANDARDS AND SPECIFICATIONS. Handicap ramps may be shown at all curb returns or called out by a general note on the development plans, but must be shown (located) on all "T" intersections. Whenever referencing a handicap ramp, call out the specific detail drawing to construct that ramp. The detail drawing in the Appendix of this chapter indicates the preference of the location of Handicap ramps. Placement of a ramp at any location other than the most preferred location shall require prior approval by the City representative. Handicap ramps to be poured monolithic with the abutting curb and gutter.
- (F) Drainage structures shall not be placed in line with handicap ramps. Location of handicap ramps shall take precedence over location of the drainage structure.
- (G) Curb cuts should not be used for commercial/industrial or high volume residential driveways. In general, when the number of parking spaces serviced by the driveway exceeds ten (10), radius returns should be used.
- (H) Where curb cuts are allowed based on traffic considerations, concentrated storm water runoff must not be discharged across the sidewalk. These flows must be directed to a sidewalk chase section. If this is not possible due to grading restraints, radius returns and a crossspan shall be used.
- (I) Curb cuts and driveways shall be constructed in accordance with the detail drawings in these STANDARDS AND SPECIFICATIONS.
- (J) Vertical alignment shall be in accordance with Section 6.16.00 of these STANDARDS AND SPECIFICATIONS.

6.20.00 CUL-DE-SACS

The following criteria shall be used for cul-de-sac horizontal geometry.

- (A) The minimum property line radius shall be fifty feet (50').
- (B) The minimum flowline radius shall be forty feet (40'). See the detail drawing in this section.
- (C) The maximum length of the cul-de-sac as measured along and between the radius point and the right-of-way line on the abutting street shall be five hundred feet (500') or a maximum of fifteen (15) residential dwelling units, whichever is greater.
- (D) Vertical alignment shall be in accordance with Section 6.16.00 of these STANDARDS AND SPECIFICATIONS.

6.21.00 DECELERATION LANES

The design of the arterial street system depends upon the proper control of access to developments. The location and design of access points must minimize traffic hazards and interference to through traffic movements. To ensure proper control, the following standards for deceleration lanes have been established. The need for deceleration lanes is established by the approved traffic study for the preliminary plat or final development plan.

- (A) Requests for exemption from the requirements for a deceleration lane shall be based upon a traffic engineering study that presents trip-generation data for the proposed development in terms of impacts upon through traffic flows. Such requests shall be reviewed by the City Representative and may be approved, except that such an approval cannot be granted if through traffic would be impeded more than three percent (3%) of the total time, more than five percent (5%) of the time during peak traffic flow periods, or if other unique circumstances warrant special design considerations.
- (B) Deceleration lanes may be required along segments of collector streets if the proposed development constitutes a potential for creating a traffic hazard or unnecessarily impedes through traffic movements.
- (C) Deceleration lanes shall have a minimum paved width of eleven feet (11') unless otherwise approved at a lesser width by the City Representative.
- (D) The vehicle storage length of the deceleration lane shall be based upon the peak hour turning volume for the development as follows:

TABLE 6.21.01
Deceleration Lanes

<u>Peak Hour Volume</u>	<u>Minimum Length</u>
35-50	40 Feet
51-60	50 Feet
61-100	100 Feet
101-200	175 Feet
201-300	250 Feet

Deviations from this criteria shall be in accordance with AASHTO "A Policy on Geometric Design of Highways and Streets", latest edition (Green Book).

- (E) The lead-in taper length plus additional deceleration length for the deceleration lane shall be based upon the posted speed limit along the street.

TABLE 6.21.02
Deceleration Tapers

<u>Speed Limit</u>	<u>Deceleration Length</u>	<u>Taper Ratio*</u>
30 MPH & Under	160 Feet	8:1
35 MPH	250 Feet	12:1
40 MPH	370 Feet	12:1
45 MPH	425 Feet	15:1
50 MPH	500 Feet	15:1

* Taper length equals taper ratio times lane width.

- (F) Deceleration lanes shall be provided for all exclusive right-turn access points (i.e., right-in/right-out driveways).

- (G) The deceleration lane and the associated signage and pavement marking shall be installed as per the requirements established by the City Representative prior to the issuance of any Certificate of Occupancy within the development.

6.22.00 ACCELERATION LANES

At intersections, it is desirable to provide acceleration lanes for vehicles turning right onto the arterial from a cross street. The design elements of these acceleration lanes shall be in accordance with Tables 505.7B and 505.7C of the Colorado Department of Transportation Roadway Design Manual.

6.23.00 OFF-SITE DESIGN

- (A) The design grade, and existing ground at that design grade, of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued in the same plan and profile as the proposed design for at least three hundred feet (300') or to its intersection with an arterial roadway.
- (B) If the off-site roadway adjacent to the proposed development is not fully improved, the Responsible Party is responsible for the design and construction of a transition for the safe conveyance of traffic from his improved section to the existing roadway. The following formula shall be applied to the taper of lane change necessary for this transition:

$$L = WS^2/60$$

Where:

L = Length of Transition in Feet
W = Width of Offset in Feet
S = Speed Limit or 85th Percentile Speed

- (C) The City of Delta Community Development Department should be contacted to establish unusual transition criteria. This contact is the responsibility of the applicant.

6.24.00 BARRICADES

Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required. Design and construction shall comply with the requirements of the Manual of Uniform Traffic Control Devices, most recent edition. Details shall be shown on the construction drawings, and installation shall be provided by the Responsible Party.

6.30.00 PAVEMENT DESIGN AND TECHNICAL CRITERIA

6.31.00 GENERAL

This section provides the basic criteria and design procedures for roadway pavements. Recommended design methodologies for asphalt and Portland cement concrete are addressed and essentially follow the Colorado Department of Transportation methodology. Some standardization of criteria has been made in design procedures.

For all City land development approvals that involve a Public Improvements Agreement for roadway construction, the applicant shall have a subgrade investigation and pavement design report prepared by a Professional Engineer registered in the State of Colorado and practicing in the field of soils mechanics that recommends typical pavement structural section based on the known site soil conditions and the valid traffic study. This pavement design serves as a justification of the roadway improvements agreement in addition to determining roadway structural requirements.

6.32.00 SUBGRADE INVESTIGATION

6.32.01 Field Investigation

The field investigation shall consist of borings or other suitable methods of sampling subgrade soils to a depth of at least three feet (3') below proposed subgrade elevation at spacings of not more than two hundred fifty feet (250') unless otherwise accepted by the City Representative. Samples shall be taken after grading is completed and the subgrade is rough cut.

6.32.02 Classification Testing

Each subgrade sample shall be tested to determine liquid limit, plastic limit, plasticity index, Atterberg limits, and the percentage passing the U.S. Standard No. 200 sieve. Samples of sands and gravels may require gradation analysis for classification determination. This data shall be determined using the following methods:

Liquid Limit	AASHTO T 89 (ASTM D 4318)
Plastic Limit	AASHTO T 90 (ASTM D 4318)
Percent Passing #200 Sieve	AASHTO T 11 (ASTM C 117)
Gradation	AASHTO T 27 (ASTM D 422)

The results of these tests shall be used to calculate the AASHTO classification and group index using AASHTO M 145.

6.32.03 Soil Grouping

To facilitate subgrade support testing, soil samples collected in the field investigation can be combined to form soil groups. These groups shall be based upon the AASHTO classification group index and location within the area investigated. Groupings shall not consist of samples with different AASHTO classifications. (Note: There may be more than one group within a given classification.) Composite samples can be manufactured by combining small portions of each subgrade sample contained within the group and mixing to provide a uniform composite sample of the soil group. Composite samples shall be subjected to classification testing as outlined in AASHTO M145.

6.32.04 Subgrade Support Testing

Individual subgrade or composite samples shall be tested to determine the subgrade support value using Hveem stabilometer (R-value) testing. Tests shall be conducted in accordance with the procedures listed below.

- (A) R-Value Tests. Hveem stabilometer tests shall be conducted in accordance with AASHTO T 190. The design R-value shall be at 300 psi erudition pressure. The reported data shall consist of:

1. Dry density and moisture content for each sample.
2. Expansion pressure for each sample.
3. Erudition pressure -- corrected R-value curve showing the 300 psi design R-value.

6.4000 STREET CONSTRUCTION STANDARDS

6.41.00 GENERAL

The purpose of this section is to set forth the criteria to be used in the construction of all streets and appurtenances within the City of Delta.

6.42.00 COMPACTION IN UTILITY TRENCHES

Before street construction will be permitted, the top four feet (4') of all utility trenches within the street right-of-way (including service lines) shall be compacted to ninety-five percent (95%) of maximum standard density and the balance of the trench compacted to ninety percent (90%) of maximum density, as determined by ASTM D 698-78 or as specified in the approved soils report. This compaction shall extend to the street right-of-way lines as a minimum. Water settlement of trenches shall not be permitted. All water and sewer services, including water and sewer main stub-outs, shall be installed prior to street construction except that curb and gutter and sidewalk shall be installed prior to water service line installation.

6.43.00 EXCAVATION AND EMBANKMENT

6.43.01 General

The intent of this section is to specify methods and standards to be used in the construction of embankments or excavations for City streets or for other purposes, as indicated on the approved drawings or contract documents. The work will include excavation, embankment, grading; compacting; clearing and grubbing; removal of topsoil, trees, stumps, or other vegetation; removal and/or resetting of minor obstructions; subgrade preparations; and any other work incidental for the construction of excavations and embankments. All workmanship and materials shall be in accordance with the requirements of these STANDARDS AND SPECIFICATIONS and in conformity with the lines, grades, quantities, and the typical cross-section shown on the plans or as directed by the City Representative.

6.43.02 Clearing and Grubbing

Work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the project, and such other areas as may be indicated on the approved plans or required by the work except such objects as are designated to remain or are to be removed in accordance with other sections of these STANDARDS AND SPECIFICATIONS. All surface objects and trees, stumps, roots, and other protruding obstructions not designated to remain shall be cleared and/or grubbed as required except non-perishable solid objects which shall be a minimum of two feet (2') below subgrade.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted in accordance with these STANDARDS AND SPECIFICATIONS. Materials and debris shall be disposed of in a manner acceptable to the City Representative. Burning shall not be permitted without prior written approval of the City Representative and the Delta county health department.

The Responsible Party shall make all necessary arrangements for obtaining suitable disposal locations. If disposal will be at other than established dump sites, the City Representative may require the Responsible Party to furnish written permission from the property owner on whose property the materials and debris will be placed. Branches on trees or shrubs shall be removed as directed. Branches of trees extending over the road bed shall be trimmed to give a clear height of twenty feet (20') above the road bed surface. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

The Responsible Party shall scalp areas where excavation or embankment is to be made. Scalping shall include the removal of material such as brush, roots, sod, grass, residue of agricultural crops, sawdust, and other vegetable matter from the surface of the ground. Hedges shall be pulled or grubbed in such a manner as to assure complete and permanent removal. Sod not required to be removed will be thoroughly disked before construction of embankment.

6.43.03 Removal of Existing Structures

- (A) The Responsible Party shall raze, remove, and dispose of all foundations, signs, structures, fences, old pavements, abandoned pipe lines, traffic signal materials, and other obstructions which are within the project limits except for utilities and for those items which other provisions have been made for removal. Traffic signals and related materials will include all attachment hardware and other incidental materials such as, but not limited to, mast arms and span wire. Concrete adhering to sign posts shall be removed, and pedestals and bases shall be removed to one foot (1') below the surrounding ground or subgrade.

Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with plan details and in such a manner that materials to be left in place will be protected from damage. The Responsible Party at his expense shall repair all damage to portions of structures that are to remain in place. Reinforcing steel, projecting from the remaining structure, shall be cleaned and aligned to provide bond with new extension. Dowels shall be securely grouted with approved grout.

Removal of sign panel shall include all work necessary to remove the panel and its attachment hardware from the existing installation. Where culverts or sewers are to be left in place and plugged, the ends shall be filled with concrete. In addition, the entire length of pipe to be left in place shall be blown full of sand. Materials used in detour structures and supplied by the Responsible Party shall be the property of the Responsible Party. After the detour is abandoned, the Responsible Party shall completely remove the detour structures and shall dispose of materials according to these STANDARDS AND SPECIFICATIONS.

- (B) Bridges, culverts, and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic. Unless otherwise directed, the substructures of existing structures shall be removed to one foot

- (1') below natural stream bottom or ground surface. Where such portions of existing structures lie wholly or in part within the limits of a new structure, it shall be removed as necessary to accommodate the construction of the proposed structure. Steel, precast concrete, and wood bridges shall be carefully dismantled without unnecessary damage. Steel members to be salvaged shall be match-marked with waterproof paint.
- (C) Unless otherwise provided, all pipe shall be carefully removed and cleaned. Every precaution shall be taken to avoid breaking or damaging the pipe. Pipes to be relaid shall be removed and stored, when necessary, so that there will be no loss or damage before relaying. When removing manholes, catch basins, and inlets, any live sewer connected to these items shall be properly reconnected and satisfactory bypass service shall be maintained during such operation.
- (D) Concrete or asphalt concrete that is to remain shall be cut in a straight, true line with a vertical face. The Responsible Party shall be responsible for the cost of removal and replacement of all overbreak. Sawing shall be done carefully, and all damages to concrete or asphalt to remain in place, which are caused by the Responsible Party's operations, shall be repaired by the Responsible Party at his expense. The minimum depth of saw cuts in concrete shall be two inches (2"). If the removed portion falls within five feet (5') of an existing joint or edge, the concrete shall be removed to that joint or edge.

6.43.04 Salvage

All salvageable material shown on the plans shall be removed without unnecessary damage in sections or pieces that may be readily transported and shall be stored by the Responsible Party in locations approved by the City Representative. The Responsible Party shall be required to replace any materials lost from improper storage methods or damaged by negligence.

6.43.05 Disposal

The Responsible Party shall make all necessary arrangements for obtaining suitable disposal locations, and the cost involved shall be included in the work. If disposal will be at other than established dump sites, the City Representative may require the Responsible Party to furnish written permission from the property owner on whose property the materials will be placed.

6.43.06 Excavation and Embankment

Excavation of whatever substances are encountered within the limits of the project shall be performed to the lines and grades indicated on approved plans. All excavated areas shall be graded in a manner that will permit adequate drainage. Whenever practicable, all suitable material removed from the excavations shall be used in the formation of embankments, for backfilling, and for other approved purposes. Where material encountered within the limits of the work is considered unsuitable, such material shall be excavated below the grade shown on the approved drawings or as directed by the City Representative and replaced with suitable material. All unsuitable excavated materials and any surplus or excavated material that is not required for embankments shall be disposed of by the Responsible Party.

Before any embankment is placed, clearing, tree removal, sod and topsoil removal over the entire area shall be performed in accordance with these STANDARDS AND SPECIFICATIONS. The base of fill areas shall be scarified to a depth of not less than six

inches (6") prior to placement of embankment material. Each layer shall be wetted or aerated, if necessary. No embankment material shall be placed upon organic, spongy, or frozen material or other material unsuitable for the placement thereof in the opinion of the City Representative. When an embankment is to be placed on slopes, it shall be continuously benched in horizontal layers to key to the existing slopes.

The construction of embankments by deposition, placing, and compacting materials of acceptable quality above the natural ground or other surface shall be in accordance with the lines, grades, and cross-sections shown on the approved plans and/or as required by the City Representative. Each lift of the embankment material shall not exceed eight inches (8") in loose depth. The Responsible Party shall thoroughly mix the different materials to secure a uniform moisture content and to insure uniform density and proper compaction. Each layer shall be thoroughly compacted by roller or vibratory equipment that is suitable for the type of embankment material to the densities specified in table found in the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, Section 203.07.

6.43.07 Select Borrow Material

In the event the material found on site is unsatisfactory for constructing subgrade, embankments, or filling excavations, the Responsible Party shall provide material from off-site.

The selected borrow material shall be a well-graded mixture of sound mineral aggregate particles containing sufficient quality bonding material to secure a firm stable foundation when placed and compacted on the roadway. The R-value of the borrow shall be equal to or greater than the design R-value required for the street. The R-value of the borrow shall be provided to the City Representative prior to placing borrow. If tests reveal that material being placed is not of suitable quality and structural value, the Responsible Party shall provide other material as approved by the City Representative.

6.44.00 SUBGRADE PREPARATION AND GRADING

6.44.01 General

The work covered by this section concerns the furnishing of all labor, equipment, supplies, and materials needed to perform preparation of subgrade within the public right-of-way. The bottom of the excavation for the pavement, or top of the fill, will be known as the pavement subgrade and shall conform to the lines, grades, and cross-sections shown on the approved plans. Prior to the street being excavated, all service cuts shall be checked to see if the backfill meets density requirements. If deficient, they shall be recompacted and brought up to the density as specified in Chapter 9, Trenching , Backfilling and Compaction.

6.44.02 Subgrade Stabilization

Embankment and subgrade soils shall be compacted to ninety-five percent (95%) of maximum standard density at plus or minus two percent ($\pm 2\%$) optimum moisture or as recommended in the approved soils report. Maximum density shall be determined by ASTM D 698-78. Soft and yielding material and other portions of the subgrade that will not compact when rolled or tamped shall be removed as directed by the City Representative and replaced with suitable material or, if written approval by the City Representative, fabric material may be used. Material shall be approved by the City prior to purchase and installation.

Subgrade surfaces below excavated areas such as cut areas and undisturbed areas shall require additional preparation. Said subgrade shall be scarified to a minimum depth of twelve inches (12"), wetted or aerated as needed, and compacted until the required density is obtained, unless otherwise approved by the City Representative. No paving, subbase, or base shall be placed on soft, spongy, or frozen unstable subgrade which is considered unsuitable by the City Representative.

The Responsible Party shall, when requested by the City Representative, furnish the necessary equipment to proof roll, even though density tests may indicate compliance. Heavy construction equipment or loaded trucks acceptable to the City shall be driven over the finished subgrade and deflections noted. Soft and yielding material and portions of the subgrade which show deflection shall be scarified and re-rolled or shall be removed and replaced with subgrade course material and then placed and compacted as specified herein. Subgrade shall not be approved for base course construction or paving until it is uniformly stable and unyielding.

6.44.03 Lime and Cement Treated Subgrade

When recommended by the approved soils report and/or pavement design, the surface of the road bed shall be bladed to the established lines, grades, and cross-sections as shown on the approved plans. The prepared road bed shall be scarified to the depth and width required for the subgrade stabilization. The material thus obtained shall be pulverized. Application, mixing, and finishing shall be in accordance with Colorado Department of Transportation Specifications, 1991 Edition, Section 307.04 through 307.07. Hydrated lime shall conform to the requirements of ASTM C 107-79, Type N.

6.45.00 SUBBASE CONSTRUCTION

6.45.01 General

The subbase shall consist of a foundation course composed of granular material constructed on the prepared subgrade in accordance with these STANDARDS AND SPECIFICATIONS and in reasonable conformity to the lines and grades and typical cross-sections as shown on the approved plans.

6.45.02 Placement and Compaction

Each layer of subbase material shall be placed in layers not to exceed twelve inches (12") in compacted depth. Each layer shall be wetted or aerated, if necessary, and compacted to ninety-five percent (95%) maximum density standard proctor at plus or minus two percent ($\pm 2\%$) of optimum moisture as determined by ASTM D 698-78. No subbase material shall be placed upon a soft, spongy, or frozen subgrade or other subgrade, the stability of which is unsuitable for the placement thereof in accordance with the approved soils report.

6.46.00**BASE CONSTRUCTION****6.46.01 General**

The intent of this section is to specify methods to be used for the construction, overlaying, sealcoating, and pavement rejuvenating of streets, parking lots, walks, drainageways, and other miscellaneous work requiring the use of aggregates. The work covered shall include general requirements that are applicable to aggregate base course, bituminous base, and pavements of the plant-mix type, bituminous prime coat, bituminous tack coat, rejuvenating applications, and asphalt concrete overly. All workmanship and material shall be in accordance with requirements of these STANDARDS AND SPECIFICATIONS and in conformity with the lines, grades, depths, quantity requirements, and the typical cross-section shown on the approved plans or as directed by the City Representative.

6.46.02 Base Course

This item shall consist of a foundation course composed of crushed gravel or crushed stone and filler, constructed on the prepared subgrade or subbase course. Construction shall be in accordance with the requirements of the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, Section 304 and the approved pavement design. The composite base course material shall be free from vegetation and lumps or balls of clay.

6.46.03 Placement and Compaction

The base course material shall be deposited and spread in a uniform layer without segregation of size to a compacted depth not to exceed six inches (6"). The material shall be compacted to a minimum ninety percent (90%) density modified proctor as determined by ASTM D 1557-78. No base course material shall be placed upon a soft, spongy, or frozen subgrade or subbase with an unsuitable stability. Base material shall not be placed on a dry or dusty foundation where the existing condition would cause rapid dissipation of moisture from the base material and hinder or preclude its proper compaction. Such dry foundations shall have water applied and shall be reworked and recompacted.

Rolling shall be continuous until the base material has been compacted thoroughly in accordance with these STANDARDS AND SPECIFICATIONS. Water shall be uniformly applied as needed during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly placed.

6.46.04 Base Surface Tolerance

The prepared surface of the base shall not vary from the approved grade by more than one-half inch (1/2").

6.47.00

BITUMINOUS CONSTRUCTION

6.47.01 Hot Bituminous Pavement

All pavement shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the City Representative and shall be a minimum of three (3") inch on local and collector and a minimum of four (4") inch on arterials. Construction shall be in accordance with the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, Section 403, and the following requirements:

- (A) The asphalt cement shall be 85-100 penetration grade.
- (B) The gradation of the mineral aggregate shall be Grading S (3/4" maximum) for new street construction. Grading SX (1/2" maximum) may be used for overlay or in special cases as authorized in writing by the City Representative.

6.47.02 Tack Coat

When tack coat is specified on the approved plans or required by the City Representative, all construction shall be in accordance with the requirements of the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, Section 407. Bituminous material shall be applied at the rate of five one-hundredths (0.05) to fifteen one-hundredths (0.15) gallons per square yard.

6.47.03 Seal Coat

When seal coat is required, all construction shall be in accordance with the requirements of the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, Section 409. The type of bituminous material, cover aggregate, and rate of application shall be as shown on the approved construction plans.

6.47.04 Rejuvenating Agent

When a rejuvenating agent is specified on the approved construction plans or required by the City Representative, all materials and construction shall be in accordance with the requirements of the Colorado Department of Highways' Standard Specifications for Road and Bridge Construction, Section 407. The rejuvenating agent shall be as shown on the approved construction plans or as specified by the City Representative.

6.47.05 Heating and Scarifying

When heating and scarifying treatment is specified on the approved construction plans or required by the City Representative, all materials and construction shall be in accordance with requirements of the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, Section 405.

6.47.06 Grinding

Grinding shall consist of milling, grinding, or cold planing the existing pavement surface to establish a new surface profile and cross-section in preparation for a bituminous overlay. After grinding, the surface shall have a grooved or ridged finish, uniform, and resistant to raveling or traffic displacement. This textured surface shall have grooves of one-quarter inch (1/4") plus or minus one-eighth inch ($\pm 1/8$).

Wedge cut grinding shall consist of grinding the existing pavement surface a minimum of six feet (6') wide at the existing concrete gutter and at all existing concrete crosspans. The edge of the gutter end or crossspan end of the finished wedge cut shall be one-and-one-half inches (1-1/2") below the edge of the existing concrete gutter or lip of pan. The centerline of the street edge of the wedge cut will be cut one-eighth inch (1/8"). The depth of cut shall be determined by measuring to the top of the ridges by placing a five-foot (5') straight edge perpendicular to the grooving pattern. Full-width grinding shall consist of grinding the existing pavement surface from edge of gutter to edge of gutter to a minimum depth of two inches (2") unless otherwise directed by the City Representative.

In grinding around utility castings, the Responsible Party may choose to remove the entire existing bituminous pavement around the castings where grinding is not completed and replace it with bituminous surface course placed and compacted in three-inch (3") lifts. The Responsible Party shall vertically cut the limits of the area to be patched, mechanically compact the existing base course, and prime the bottom and vertical edges before backfilling. The Responsible Party shall remove the cuttings immediately behind the grind machine by belt loader, end loader, power sweeper, and/or by hand. The removed material shall be disposed of as approved by the City Representative.

The grinding machine shall be a power-operated, self-propelled machine having a cutting drum with lacing patterns that will attain a grooved surface and produce grinding chips of less than one inch (1") in size. The grinding machine shall be equipped with a pressurized watering system for dust control. The equipment shall be a type that has successfully performed similar work.

The cleaning equipment shall be a type that will efficiently remove all loosened material and load into trucks for hauling and spreading. Because of the nature of the streets to be ground and the traffic restrictions, a belt loader followed by a power sweeper and manual sweeper is the most desirable method. Flushing into the City's storm sewer system as a means of clean-up will not be allowed.

6.48.00 APPURTENANT CONCRETE STRUCTURES

6.48.01 Curb and Gutter Section

The section to be constructed shall be as identified on the approved plans or as shown on the detail drawings.

6.48.02 Sidewalks

Sidewalks shall be four inches (4") thick and constructed to the dimensions shown on the approved construction plans. All areas of sidewalk that will be crossed by driveways will be constructed with six-inch (6") thick concrete in residential areas and eight-inch (8") thick concrete in commercial areas. Sidewalk shall have four inches (4") thick aggregate base course foundation uniformly placed and compacted as in Section 6.46.03.

6.48.03 Crosspans and Curb Return Fillets

Crosspans and curb return fillets shall be constructed six inches (6") thick with six by six/ten-ten (6x6/10-10) wire mesh. Typical crossspan sections are shown on the detail drawings. Where unusual conditions prevail, additional reinforcing steel and special joints may be required by the City Representative.

6.48.04 Curb Cuts and Driveways

Curb cuts shall be provided at all driveway locations and at additional locations, as shown on the approved plans. Construction of curb cuts shall be as shown on the detail drawings. Spacing will be as shown on the approved plans or as approved by the City Representative.

6.48.05 Curb Ramps

Curb ramps for the handicapped shall be installed at locations designated by the detail drawing in the Appendix of this chapter. The detail drawing in the Appendix of this chapter indicates the preference of the location of handicap ramps. Placement of a ramp at any location other than the most preferred location shall require prior approval by the City representative and at all intersections unless approved otherwise by the City representative. Curb ramp design shall comply with the most current ADA requirements.

6.48.06 Construction Stakes

The Responsible Party's surveyor shall provide all stakes required for curbs, gutters, walks, and structures and shall furnish all necessary information relating to lines and grades. The Responsible Party shall be held responsible for the reasonable preservation of all such stakes. The Responsible Party shall not remove stakes until three (3) working days after placement of concrete unless approved by the City Representative.

6.48.07 Backfilling

When side forms are removed, the space adjoining the concrete shall be backfilled, by the Responsible Party, in a timely manner with suitable material properly compacted and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill shall be level with the top of the concrete for at least two feet (2') and then sloped to the property line. Maximum slope shall be four horizontal to one vertical (4H:1V). Where detached walks occur, the space between the curb and walk shall be backfilled on a straight line from the top of walk to the top of curb.

6.48.08 Connections with Existing Concrete Curb, Gutter, and Drives

Where new construction abuts existing, the work shall be accomplished so that no abrupt change in grade between the old and new work results.

6.49.00 MONUMENTATION

Centerline monuments shall be set at each street intersection and at the end and beginning of horizontal curves, upon completion of street construction. If an existing street is to be resurfaced, monuments shall be reset, restored, or set as necessary. In paved streets, the bar and cap shall be set in concrete and shall be set under a valve box cover labeled “survey”, in accordance with the detailed drawing in the appendix of this Chapter. The cover shall be set at finished grade.

6.50.00 PARKING DESIGN

6.50.01 Regular Parking

Conventional parking layout dimensions are provided in Table 6.50.01 and the detail drawings in the Appendix of this Chapter. Other angled parking layouts meeting the approval of the City Representative will be permitted where possible.

TABLE 6.50.01
Minimum Parking Layout Dimensions (In Feet) for 9-Foot Regular Parking Stalls
at Various Angles

<u>Dimension</u>	<u>On Diagram</u>	<u>0</u>	<u>45</u>	<u>Angle</u>			<u>90</u>
				<u>60</u>	<u>75</u>		
Stall Width, Parallel to Aisle	A	9.0	12.7	10.4	9.3		9.0
Stall Length of Line	B	24.0	24.5	21.5	19.5		18.0
Stall Depth to Wall	C	9.0	17.0	18.5	19.0		18.0
Aisle Width Between Stall Lines	D	12.0	12.0	16.0	22.0		24.0
Stall Depth, Interlock	E	9.0	14.8	17.0	18.3		18.0
Module, Wall to Interlock	F	30.0	43.8	51.5	59.3		60.0
Module, Interlocking	G	30.0	41.6	50.0	58.6		60.0
Module, Interlock to Curb Face	H	30.0	41.8	49.4	56.9		58.0
Bumper Overhang (Typical)		0.0	1.5	1.8	2.0		2.0

6.50.02 Allowable Grades Permitted in Parking Lots

Minimum grades shall be the same as the grades set forth in Section 6.18.01. Maximum grades permitted in parking lots must not exceed eight percent (8%).

6.50.03 Handicapped Parking Requirements

Each handicapped parking stall shall be eight feet (8') in width with a five foot (5') unloading area, must have a stall depth of at least twenty four feet (24'), and be located near buildings and handicap ramps. The minimum required number of spaces is indicated in Table 8.12.02 below. A handicapped parking space will be required to be identified by an official "Handicapped Reserve Parking" (Manual on Uniform Traffic Control Devices, R7-8) sign with the handicapped person logo.

In order for handicapped parking spaces to function as intended, they will be required to be designed and signed in a uniform manner to allow for a clear understanding of the parking zone and to make enforcement possible. Signing of one, two, or three spaces for handicapped parking spaces must be done by using one sign for each space placed at the center of each end line.

Table 6.50.02
Minimum Required Number of Handicap Accessible Spaces

TOTAL PARKING SPACES IN LOT OR GARAGE	MINIMUM REQUIRED NUMBER OF ACCESSIBLE SPACES
1-25	1
26-50	2
51-75	3
76-100	4
101-150	5
151-200	6
201-300	7
301-400	8
401-500	9
501-1,000	2% of total spaces
Over 1,000	20 spaces plus 1 space for every 100 spaces, or fraction thereof, over 1,000

6.50.04 Parking Structures

For design details and optimum layout of parking structures, reference to Parking Garage Planning and Operation, by the Eno Foundation for Transportation, Inc., Westport, 1978, or the Urban Land Institute Standards is recommended. The City will evaluate designs for such structures on an individual case basis.

6.60.00

BRIDGES AND MAJOR DRAINAGE STRUCTURES

6.60.01 General

- (A) All culvert pipe, box culverts, and bridges that will ultimately be maintained by the City of Delta shall conform to the following:
 - 1. AASHTO "Standard Specifications for Highway Bridges," latest edition, and applicable interims.
 - 2. Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," latest edition.
 - 3. Colorado Department of Transportation's "Bridge Manual," Volumes I and II.
- (B) All structures shall be designed to an HS-20 loading.
- (C) All box culverts and bridges shall have the year of construction permanently indented on the downstream headwall face in legible numbers. The numbers shall be three inches (3") high by one-and-one-half inches (1-1/2") deep in the headwall face.
- (D) All box culvert and bridge designs shall be certified by a Professional Engineer registered in the State of Colorado who is competent to perform such designs.

6.70.00

CONSTRUCTION TRAFFIC CONTROL

6.70.01 General

Traffic control devices shall be maintained in a safe operating condition at all times. The Responsible Party shall provide for approval by the Traffic Engineer, a traffic control plan, and shall comply with Chapter 8 of these STANDARDS AND SPECIFICATIONS. If the City Representative finds the construction area to be inadequately barricaded, he has the authority to stop work and direct that corrective measures be taken prior to proceeding with work.

6.70.02 Pedestrian Traffic

Every precaution shall be taken to ensure that construction work does not interfere with the movement of pedestrian traffic, which shall be maintained on the sidewalk at all times. Flagmen shall be provided for guidance as necessary.

- (A) Where an excavation interrupts the continuity of the sidewalk, the Responsible Party shall provide suitable bridge or deck facilities to be supplemented by the use of such proper devices and measures as prescribed in the Manual on Uniform Traffic Control Devices, most recent edition, for the safe and uninterrupted movement of pedestrian traffic. The edges or ends of the pedestrian bridge or decking shall be beveled or chamfered to a thin edge to prevent tripping.
- (B) Temporary diversion walkways shall be hard surfaced and electric lighting shall be provided and kept continuously burning during hours of darkness, when required by the City Representative.

- (C) Unless otherwise authorized by the City Representative, pedestrians shall not be channeled to walk on the traveled portion of the roadway.
- (D) Under certain conditions, it may be necessary to divert pedestrians to the sidewalk on the opposite side of the street. Such crossings shall only be made at intersections or marked pedestrian crossovers.
- (E) Facilities satisfactory to the City Representative shall be provided for pedestrian crossing at corners, pedestrian crossovers, and public transportation stops.

6.70.03 Vehicular Traffic

- (A) Construction work zone traffic shall be controlled by signs, barricades, detours, etc., which are designed and installed in accordance with the Manual on Uniform Traffic Control Devices, most recent edition, and applicable City of Delta traffic standards. Traffic control plan shall be submitted and approved by the City Representative or his designee prior to start of any construction.
- (B) During construction of new facilities, traffic control should strive to keep the motorist from entering the facility. The primary means to accomplish this is by use of temporary barricades, located in advance of the point where new construction joins existing, and by appropriate signing. New construction shall not be opened to traffic and, thus, the construction traffic control removed without the approval of the City Representative.
- (C) In general terms, a construction traffic control plan must be drawn on a map. For minor projects or local roadways, a neat sketch of the roadways and the proposed control devices will suffice. For major projects or major roadways, the traffic control plan should be superimposed on record drawings, construction plan drawings, or other detailed map.
- (D) The Manual on Uniform Traffic Control Devices shall be the basis upon which the construction traffic control plan is designed in concern with proper, prudent, and safe engineering practice. All necessary signing, striping, coning, barricading, flagging, etc. shall be shown on the plan.
- (E) Directional access on roadways may be restricted [minimum travel lane width in construction area is ten feet (10')], but proper controls including flagging must be indicated. Removal of on-street parking should be considered and noted where applicable.

6.80.00 MATERIAL SPECIFICATIONS

6.81.00 SUBBASE

Subbase material shall be composed of granular material consisting, essentially, of sand, gravel, rock, slag, disintegrated granite, or a combination of such materials. The coarse portions of the material shall be sound fragments of the crushed or uncrushed materials enumerated above. Supplied material shall be a well-graded mixture containing sufficient soil mortar, crushed dust, or other proper quality binding material which, when placed and compacted in the roadway structure, will result in a firm, stable foundation. Material composed of uniform size particles, or which contains pockets of excessively fine or excessively coarse material, will not be acceptable for use.

This material need not be crushed but shall be graded within the following limits:

TABLE 6.81.00

<u>Standard-Size of Sieve</u>	<u>Percent by Weight Passing Sieve</u>
2-1/2 Inch	100
2 Inch	95 - 100
No. 4	30 - 60
No. 200	5 - 15

Liquid Limit -- 35 Maximum
Plasticity Index -- 6 Maximum

6.82.00 BASE

Base shall consist of a foundation course composed of crushed gravel or crushed stone and filler constructed on the prepared subgrade or subbase course. Materials and construction shall be in accordance with the requirements of Table 703-2 of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," Section 703. Gradation shall be Class 6 (3/4-inch maximum) in accordance with the Table 703-2.

6.83.00 BITUMINOUS MATERIALS

6.83.01 Prime Coat

Materials shall be in accordance with the requirements of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," Section 702. Bituminous material shall be MC-70 or cut-back AC-10 may be used if approved by the City.

6.83.02 Hot Bituminous Pavement

All pavement shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the City Representative. Materials shall be in accordance with the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," Sections 702 and 703, and the following requirements:

- (A) The asphalt cement shall be 85-100 penetration grade.
- (B) The gradation of the mineral aggregate shall be grading C (3/4-inch maximum) for new street construction. Grading CX (1/2-inch maximum) may be used for overlay or in special cases as authorized in writing by the City Representative.
- (C) When tested in accordance with the requirements of ASTM D-1559, the mixture will conform to the following limits:

Stability (minimum)	1,000
Flow (minimum) hundredths of an inch	8
Flow (maximum) hundredths of an inch	16
Percent Voids	3-5
Percent Voids Filled With Bitumen	75-85

Determination of the effect of water on the cohesion of the bituminous mixture shall be made in accordance with AASHTO T-165. Retained strength shall be a minimum of seventy-five (75). The use of an "anti-stripping" admixture to improve the retained strength characteristics will be permitted only by written permission of the City Representative. The cost of admixtures shall be borne by the Responsible Party.

6.83.03 Tack Coat

When tack coat is specified on the approved plans or required by the City Representative, all materials shall be in accordance with the requirements of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," Section 702. Bituminous material shall be SS-1 emulsion, diluted by mixing one (1) gallon of SS-1 emulsion with one gallon of clean water.

6.83.04 Seal Coat

When seal coat is required, all materials shall be in accordance with the requirements of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," Section 702. The type of bituminous material, cover aggregate, and rates of application will be as shown on the approved construction plans.

6.83.05 Rejuvenating Agent

When a rejuvenating agent is specified on the approved construction plans or required by the City Representative, all materials shall be in accordance with the requirements of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," Section 702. The rejuvenating agent shall be as shown on the approved construction plans or as specified by the City Representative.

6.83.06 Appurtenant Structures Concrete

Concrete used in the construction of curb, gutter, sidewalk, drive cuts, and other appurtenant roadway concrete structures shall be in accordance with Chapter 6 of these STANDARDS AND SPECIFICATIONS.

6.84.00 STRUCTURE BACKFILL MATERIAL

Structure backfill shall comply with Colorado Department of Transportation's specifications for Class I material and meet the following requirements from laboratory sieves:

TABLE 6.84.00

<u>Sieve Designation</u>	<u>Percent by Weight Passing Lab Sieve</u>
2 Inch	100
No. 4	30 - 100
No. 50	10 - 60
No. 200	5 - 20